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Appendix A

REPORT FROM CHANTIERS NAVALS DE LA CIOTAT

Mr. Gaillard, CNC, France

1. INTRODUCTION

The aim of the this report is tO present the C.N.C. adaptation of the AUTOKON System . Voluntarily have chosen a practical approach for the first 3 chapters in order to clarify the encountered user-problem and to describe necessary developments during the implementation and use of AUTOKON.

Such a system must sooner or later be evaluated on the basis of available resources mobilized by the system and on on the engendered expenses . The chapter 4 of the report yields in a rather precise way the nunber of man hours and the number of computer hours for a big tanker constructed at C.N.C.

It is almost certain that this approach, if adopted by the other shipyards present at this meeting, may lead to very fruitful discussions.

2. THE AUTOKON SYSTEM AT C.N.C.

2.1. Available programs

.C.N.C. has used ATOKON in 2 versions :

- from November 1970 to November 1971 : AUTOKON 1
- from November 1971 and up to present date : AUTOKON 7l/Intermediary version.

The ater version contains the following programs:

- FAIR 2 + DRAw 2
- LANSKI + SHELL 2 + TEMPLATE
- TABELL + NYRISS
- PART
3 - NEST 2 + PRODA.

2.2. Implementation phase

The offices concerned by the imlementation and the use of AUTOKON belong to 2 different departments at C.N.C. :

a) Design department.

The drawing office for the lines plan and hydrostatic calculations (B.E.C.) carries out a fairing procedure of the body plans based upon manually developed hull forms. The AUTOKON program FAIR 2 is used for this purpose. Two draftsmen take care of the fairing.

The Hull drawing office (B.E.C.N.) completes the body plans by :generating longitudinal curves using the LNGIN module of LANSKI. BY aid Of SHELL 2, the same office makes a preliminary shell plate development of curved plates for the purpose of material specification. One draftsman is partly occupied by these tasks.

The Scientific Section ensures the maintenance and the developments of the programs and gives technical assistance when the users encounter particular problems. Besides, this section carries out the daily AUTOKON computer runs.

b) Production department

- The Numerical Drawing Service is the C.N.C. office most concerned by AUTOKON activities and it handles the following principal jobs:

  Definition of the table of longitudinal elements

  Shell plate development and templates

  Part generation

  Nesting.

2.3. Available resources

a) Computers

One IBM 370\145 768 K with

- 4 mag. tape stations, type 3420, having l600 bpi, **9** tracks and 120 K 0\sec.
- 2 disks, type 3330, having 800 million octets in line
- operating system : os/vsl.

- One IBM 1130\8 K which can if necessary be coupled to the the IBM 370\l45 as on-line terminal.

b) Drawing machines

C.N.C. has at their disposal 2 KONGSBERG drawing machines : a type 1830 in the Production department and a type 2637 in the Design department; the latter being used for body plans and completed body plans in scale 1 : 10. Each of the tables is controlled by a HONEYWELL H 316 computer.

c) NC equipment

4 Logatomes (AIR LIQUIDE) can be optically or numerically controlled by :

directors_CC 200 - 2 axis mode

2 KONGSEERG directors CC 300 - 3 axis mode

3. DISCUSSION ON THE AVAILABLE SOFTWARE

3.1. General remarks

This discussion deals mainly with the modifications carried out by C.N.C. in order :

- to correct detected errors
- to adapt the software to our particular demands
- to improve the program performances.

Our basic intention is to have confidence in the SRS developed programs and only to carry out modifications if intense use shows that it is necessary. In other words, modifications depend entirely on the results of programs. This policy, howevcr implies a good knowledge of the programs, but it had becone necessary in the beginning when taking into account the following 3 constraints :

- the absence of an SRS maintenance group as well developed as now
- the difficulties of information exchange due to the distance

  especially the delay of urgent decisions needed for some problems.

We are aware of the possibility that this policy may not be agreed upon by other yards or SRS.

The improvements have been developed taking into account that system versions such as ALKON exist having a better performance than our present version. By this means we have tried to avoid useless expenses in manhour and money.

3.2. Error induced modifications

When considering the size of the AUTOKON system, it becomes evident that these programs cannot be completely free of errors of different origins. The number of detected errors generated during the programming phase of AUTOKON We not been overwhelmingly large. As they are only of minor interest, we will shortly give a survey of encountered principal problems :

FAIR 2 suffers from following 4 points :

- Insufficient precision of the intersection calculations especially around the endings

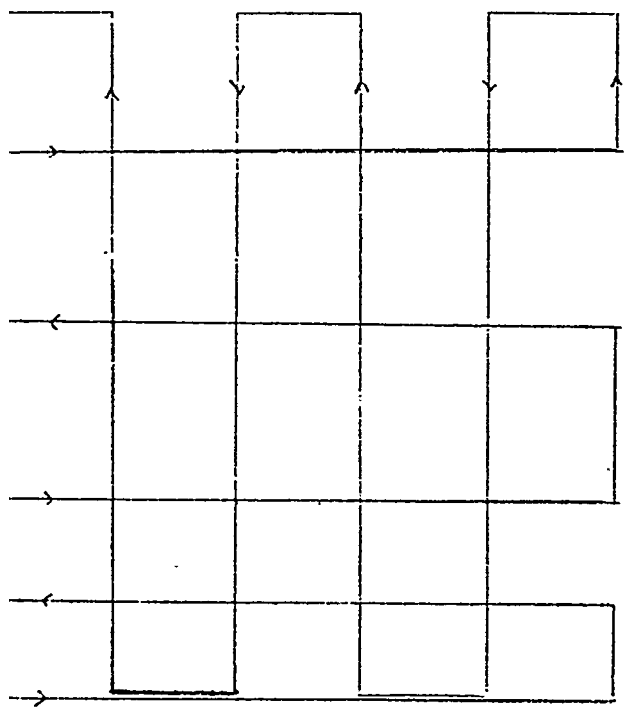
  Initial impossibility of using more than 350,extra points (input\output errors in the file of extra points)
- For the transverse frames, wrong selection of ending points on the side
- Impossible to use the direction curves called BDRD.

DRAW 2 (last SRS version) :

- Impossible to draw the space curves in their 2 plane projections of fairing.

LANSKI :

Our comments are related to the modules PCURV and PRNUT. When considering PCURV, it was impossible to draw a network if the starting point was identical to the final point (see figure N0.1)



Start and end point

FIGURE No 1
LANSKI

The longitudinal curves are reduced to a point in certain projections, e.g. longitudinal curve on the parallel middle body plating parallel, to the x-axis will be shown in the yz-plane as a point.

TO avoid punching of drawing tape, the program PCURV tested Whether the first and the, last point are the same (tolerance ε) or not. This test has been replaced by a test of the length of the projected curve.

Concerning PRNUT, the angls E and F vary every time LANSKI calls this module.

NEST 2 :

The use of this module at C.N.C. raised the following three points of criticism:

- Poor elimination of small elements, i.e. elements where the $|\Delta u|$ and $|\Delta v|$ are both inferior to a given fixed tolerance. The Auxiliary Function Word (AFW) of the deleted element was assigned to the next element.

  In the chord fitting subroutine, the AFV of the circular elements was assigned to all generated chords leading to errors if the positions should be edge marked.

  Due to a wrong calculation of the auxiliary funtions for edge marking (we remember that these functions are based on the normal direction of the element in question for edge marking) the determination of the direction was false. This problem was repeated in PART.

SHELL 2 in its old version has a wrong development of the plates crossed by tangency lines in the bottom or at the side. This problem has not yet been solved at C.N.C. in spite of the information furnished by SRS because of the structure of our SHELL 2 version.

3.3 Modifications for obtaining better methods

The improvements consist of either new possibilities introduced in existent programs or completely new programs based on the experience gained during the use of AUTOKON.

3.3.1. New possibilities within the AUTOKON system

FAIR 2 :

In its original form, the space curves gave as results the points for all the TFR, WL, BTCK intersecting the space curves concerned. This could be inconvenient, e.g. if the points which are necessary *for* the determination of the water line endings are obtained from the space curves, then it is sometimes not useful to include the so-obtained point when carrying out fairing of the frames in the extreme fore part or after body of the ship (cf. point A in figure No 2) .

This difficulty has been solved by introducing in the definition of the space curves the possibility of choosing the projections, where one wants to conserve the intersection points. This is done by an intermediary indicator.

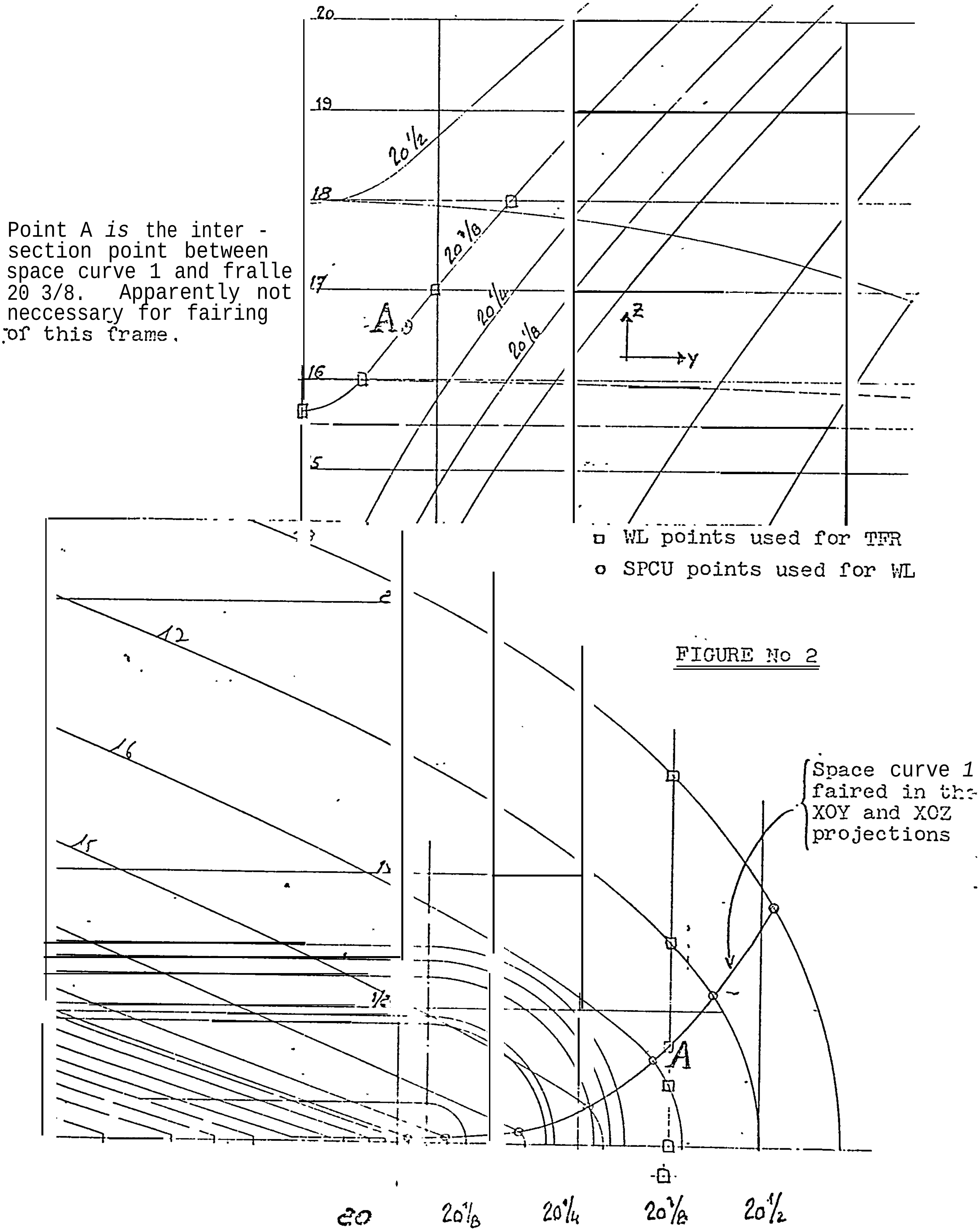

Point A is the inter - section point between space curve 1 and fralle 20 3/8. Apparently not neccessary for fairing of this frame.
□ WL points used for TFR
o SPCU points used for WL
Space curve 1 faired in the XOY and XOZ projections
20
19
18
17
16
5
20½
20 3/8
20¼
20⅛
A
Z
Y
12
16
15
½
20
20⅛
20¼
20 3/8
20½

FIGURE No 2

LANSKI :

A new possibility of def ining longitudinal curves in the yz - projection (transverse plane) has replaced the standard LANSKI possibility SLYZ (see figure No 3) .

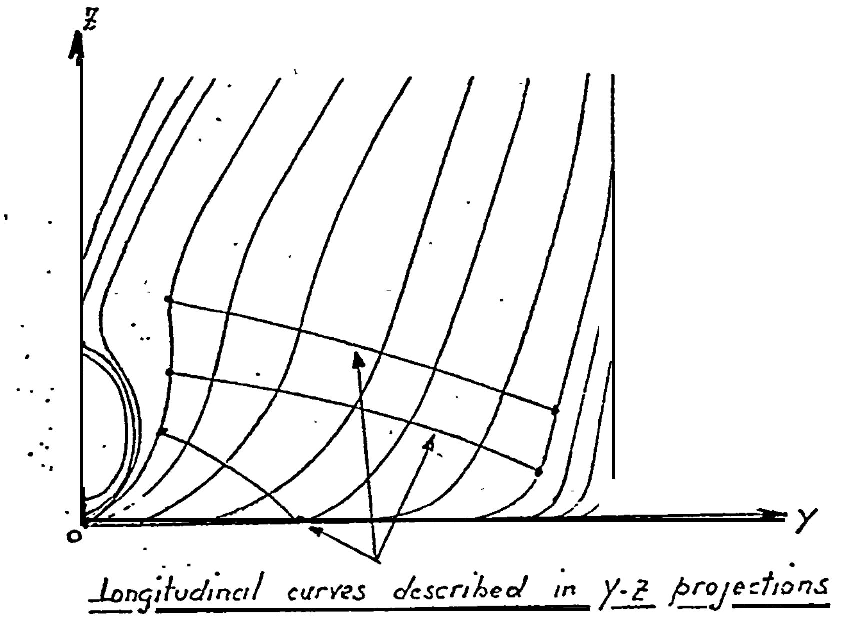


FIGURE No 3

In defining internal closed transverse sections (originally created for self-supported tanks and double hull) we obtain 2 intersection-points when cutting the transverse plane by a longitudinal vertical plane (see figure No 4 points A and B) .

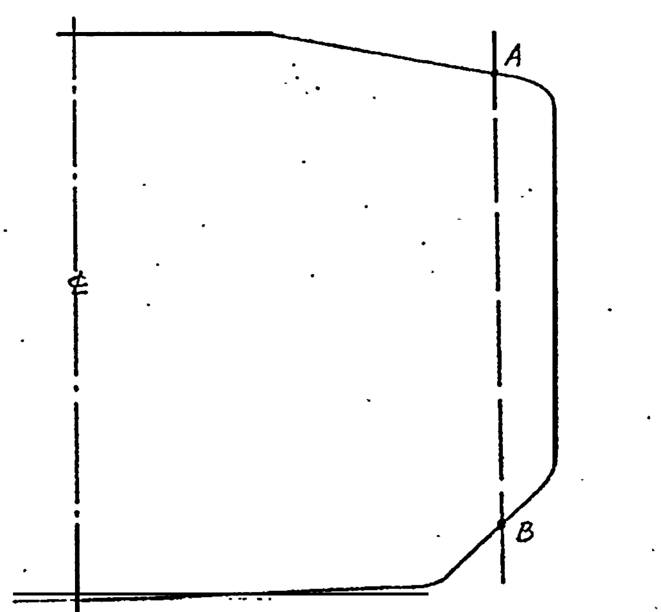


FIGURE No 4

Implicitly we have to choose one of these points either in the bottom or on the top in order to define the corresponding longitudinal curve. For each frame this choice is done as a function of a height approximation indicated in the heading of longitudinal curve in question (data sheets LNGIN).

The determination.of the abcisses in the data sheet for LNGIN was given as

frame number $\pm$ ΔX.

This approach was not possible, if 4X *was* greater than the mesh distance value, which forced us to change the quotation system for certain plans. A modification of the program has been carried out allowing *us* to let ΔX be arbitrarily chosen.

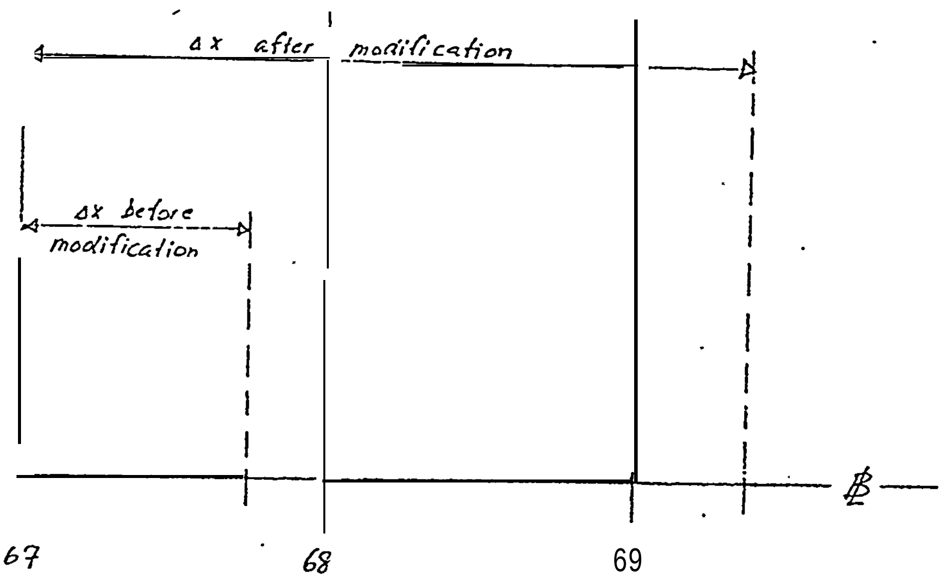


FIGURE No 5

PUNK punches, normally framewise, the table of the longi. tUdinal elements, However, the punching for a given frame Call be suppressed if it has no cut-outs.

If an asymmetrical transverse frame (asymmetric when considering the GENACONs) does not have any cut-outs where the longitudinals, causing this asymmetry, intersect the frame, then the frame in question will be declared symmetric.

PLTUT :

Now SRS has well. improved the visualization process in using drawing machines. But, before SRS, it was necessary to carry out ourselves a number of modifications, which as seen below are concentrated on the module PLTUT :

For the sake of clearness of the plans, the frame spacing in the projections XB, XZ, XY is drawn as marks of 200 m in length (full scale). Generally, the C.N.C. plans are scaled 1 : 100, thus giving marks of 2mm in length.

Choice between 3 kinds of dotted lines.by aid of the drawing table functions connected with the H 316 computer of the drawing table.

For all projections, the axis may have different scale ratios, e.g. 1 : 50 on the x-axis and 1 : 10 on the J-axis . This possibility is mainly used for drawing diagonals on the one-tenth drawing checking the body Plan fairing.

Longitudinal curves are classed as :

LONG)
SEAM) standard LANSKI
DECK)

CARL) (CARLingue = girder
SERR) C.N.C. standards : (SERRE = stringer
PLDF) Plafond, Double Fond =
[top, double bottom

By aid of the above-mentioned key-words, our original LANSK1 program may handle either all the curves belonging to the same class by giving. one key-word or certain curves from a class by specifying the key-word plus the lower and upper number of long. curves.

Possibility of windowing the lmgitudinal curves by indicating the upper and lower frame of the window (see figure NOS 6a and 6b) . In the XB,.XY and XZ projections, one obtains curves going from X min to X max. Outside this range the longitudinal curves are not drawn. In the YZ projection (body plan) the program gives, as shown in figure No 6b, not only long l curves but also the intermediary frames. This possibility is very useful for the generation of working drawings.

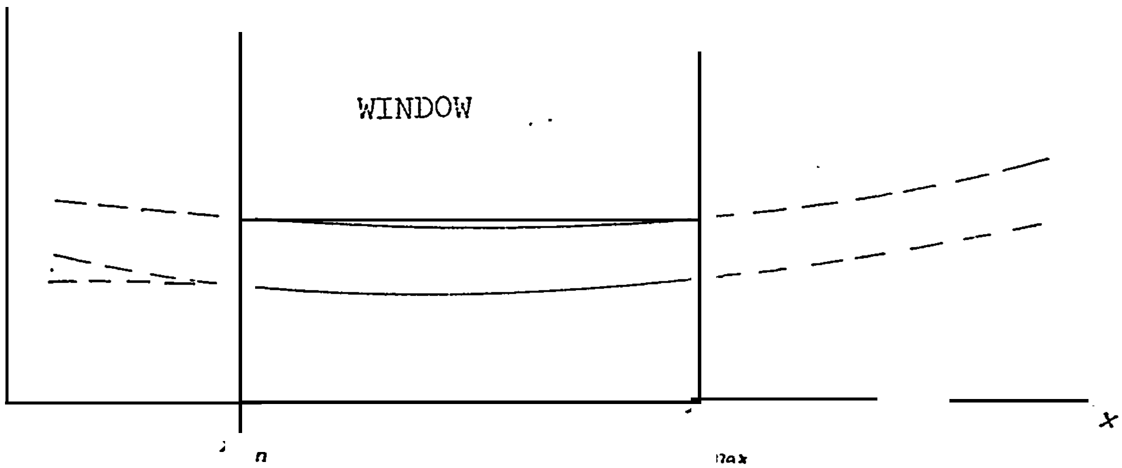


FIGURE NO 6a

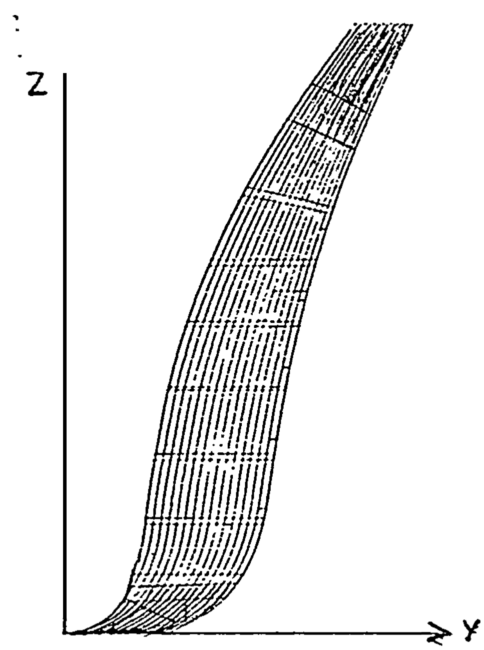


FIGURE No 6b

- Compression of SSSI elements to avoid punching of non-fundamental elements (see figure No 7). This leads to a reduction of numbcr of punched cards and tapes .

Apparently these nodifications seen unnecessary when . considering the *actual level of* LANSKI, but it must be rcmbered that some of the,n were clone before the ne::er *SRS* modifications.

In this paper we have voluntarily left out of consider.2-tion the schematiztion of the C.N.C. formats for the computer outputs.

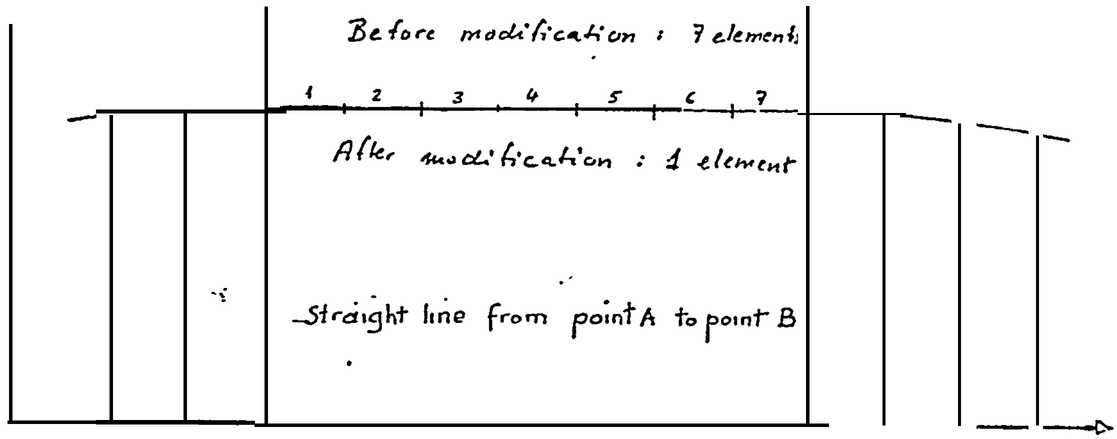


FIGURE NO 7

TABELL :

The C. N .C. version of TABELL permits directly filling in the table of longitudinal elements from the LANSKI Data Base to the AUTOKON Data Ease.

SHELL 2 :

The developed shell plates having the edges flame-cut are defined by straight line segments (which can be seen on drawings in scale 1 : 10; see figure No 8). Curve fitting is then carried out by BSCIRK.

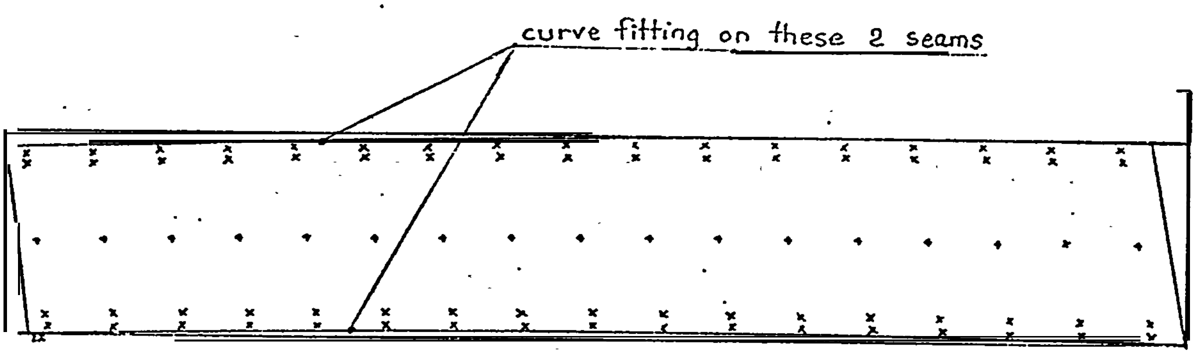


FIGURE NO 8

NYRISS :

The C.N. C. version permits to fill in the frames from the new FAIR 2-E tape. The maximum number of elements per frame has been increased from 120 to 200 AUTOK0N elements.

PART :

USing the-time cIOCk of the computer the datum is stated in the headings of each listing to ease the data card classification and card corrections. The computer also tests the newbuilding number in order to avoid errors in the card manipulation and to ensure that structural items of one ship are not allocated another ship data base . (The newbuilding number is indicated on the JCL card) .

3.3.2. Developments and new programs

a) OS/VS : Version IBM OS/VS 370/145 with 3330 disks exists now for all programs.

b) FORTRAN : Change in computer language from FORTRAN G to extended FORTRAN H with optimizer, which has decreased CPU time, e.g. on the new Part Coding program; (without structure overlay) a gain of 20% CPU is observed.

c) SCKERF : is a program for kerf width compensation. The problem is c connected with the AUTOKON description of the parts using the theoretical dimensions. After flame-cutting the resultant dimensions of the parts in question are diminished along the contour by l\2 width of the kerf.

The aim of our modification was to correct the parts results before flame-cutting so that the dimensions after the frame-cutting process correspond better to the theoretical ones.

The method consists in carrying out partwise the necessary compensation. Each part exists then in the Data Base in 2 different forms :

- as a result of the part coding
- as a result of the SCKERF program.

Evidently this occupies more file space but it allow’s us to simplify the treatment. of the part geometrical elements which should not be compensated (rapid *tra*verse) .

The program has 4 calculation sequences :

Reading phase : partwise taken from the Data Base.

Dilation (or inverse) sequence of each part is ensured by an intersection supervisor.

Calculation of a net! contour if certain intersections cannot be determined.

Storage on disk of the new dimensions (new part number = old part number + 200000) of the expanded part.

The nesting is of course made in using the compensated pieces.

d) SCFORINT : calculates simple geometrical contours. When looking at a transverse section of an LPG carrier (See figure No 9), we can detect several cutouts on :

- the hull side
- the double hull
- the external contours of the tanks, and on
- the internal contours of the tanks.

The basic idea was to treat by AUTOKON, in the same way as the outer contours, all the internal contours (classified by level) and parts, i.e. for each level:

1) to define the transverse sections by AUTOKON elements (thus obtaining a result equivalent to Fair 2) l

2) then use LANSKI to define all the longitudinal curves and the table of longitudinal elements.

3) finaily applying in, the Part Coding (using GENACONS) the previously defined contours with cut-outs.

The contours are classified as follows going from the outer contour inwards, e.g.

level O : Hull . . . . No TFR
level 1 : Double hull . . . . No TFR + 1000
level 2 : Tank contour . . . . . No TFR + 2000.

The contour determination has its origin in a simple VOlume description using a plane conception with either sharp plane plane-intersections (see figure l0a) or with cylindrical corners (see figure No 10b). Figure No 11 shows an example in three dimensions of . the tank geometry of an LPG carrier. These volumes have-been defined previously by hand and all information concerning this description is contained in some of the general geometry pians. FORINT, therefore, is more a descriptional than a conceptional algorithm, that we had built up with special care for simple handling and fast calculations.

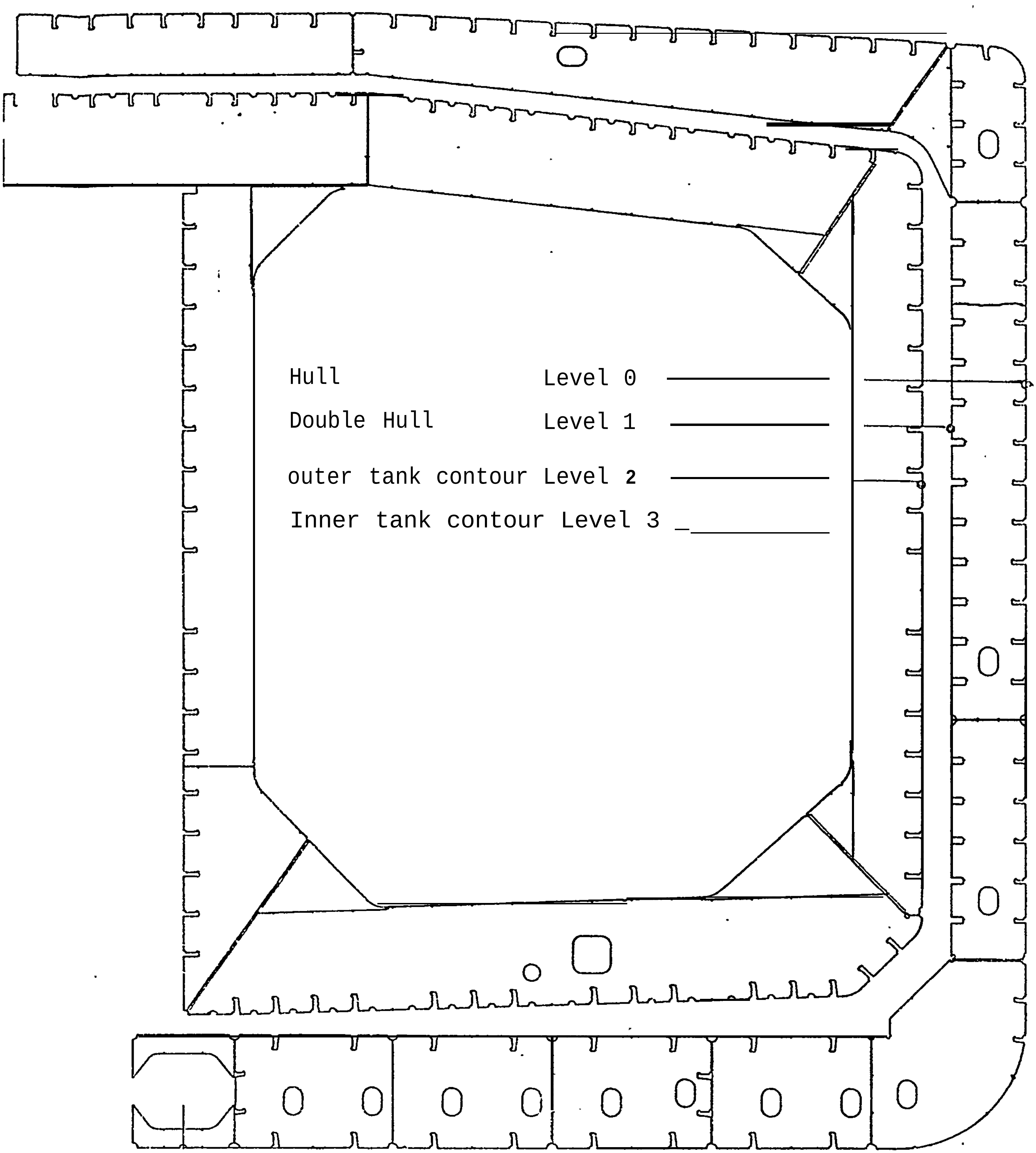
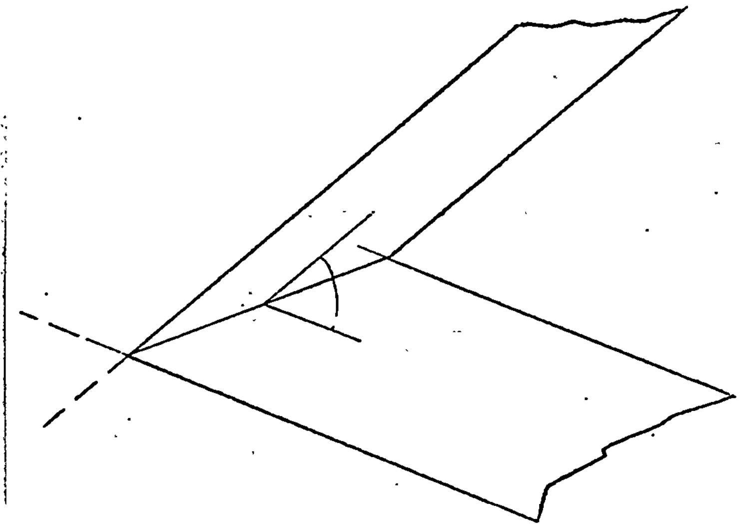


FIGURE No 9
Transverse structural. elements of an LPG tanker



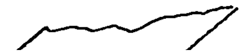


FIGURE No 10a FIGURE NO 10b

The input data consists among other things of a three dimensional description of Knuckle lines linking plans together by specifying :

- the coordinates of boundary points on the knuckle line or some other elements that allow the program to calculate the corresponding coordinates.

  if necessary, the radius of the cylindrical corneus (see figure No 10b) .

The results are presented in 2 different ways :

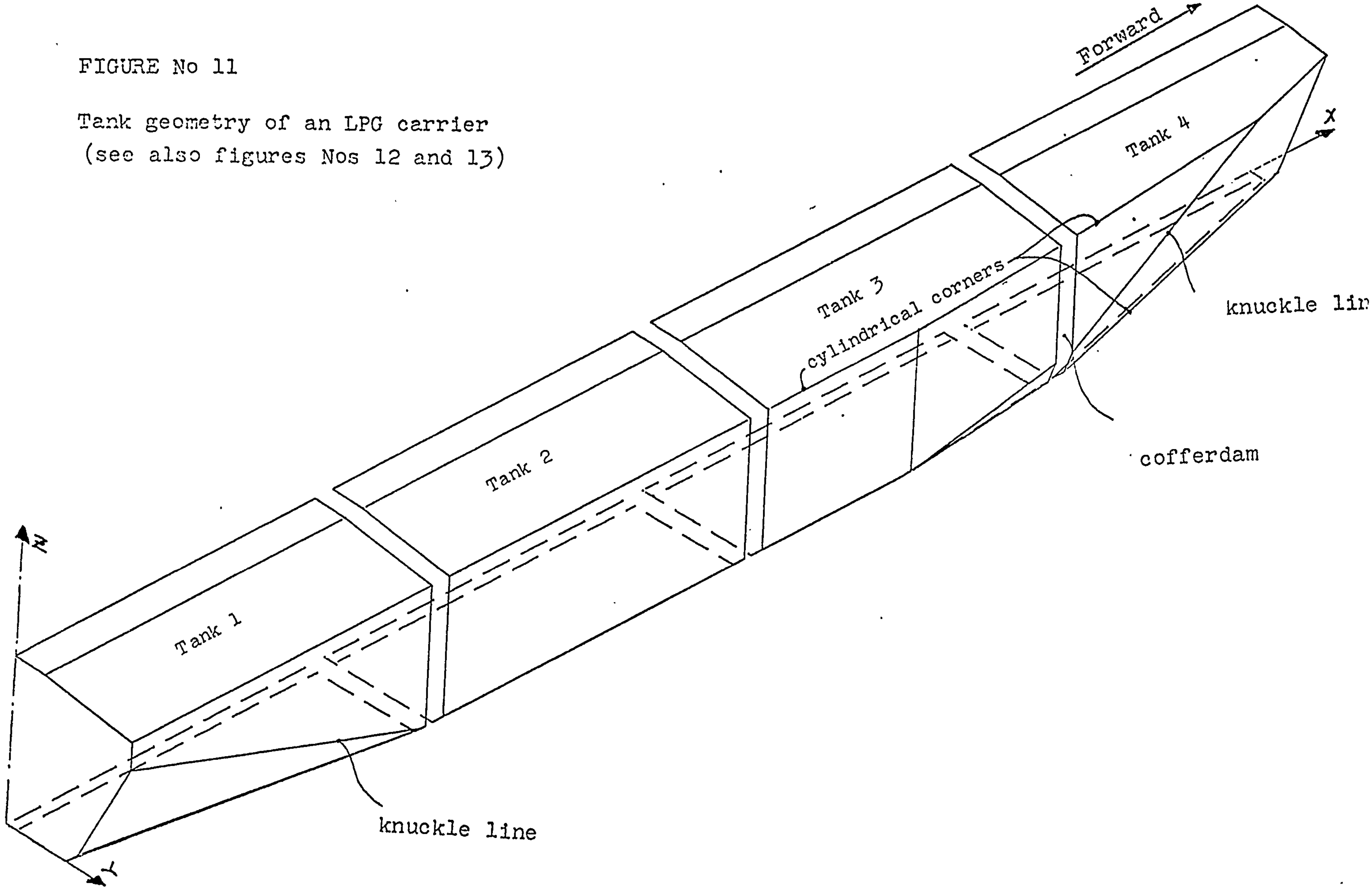
on line printer : List of input data.
Intermediary calculation of coordinates having been. implicitly defined.
List of the curve spacings.
Error messages.
AUTOKON elements of the curves.

- as a file like FAIR 2 allowing : drawing of the curves with the program DRAW 2 (see figures Nos 12 and l3),
transferring transverse sections to the Data Base disk,
to use LANSKI.

The longitudinal curves : The FORINT calculated contour can be closed, if the input data has been manu.-*ally* sorted; this has given rise to some problems

FIGURE No 11

Tank geometry of an LPG carrier
(see also figures Nos 12 and 13)



391

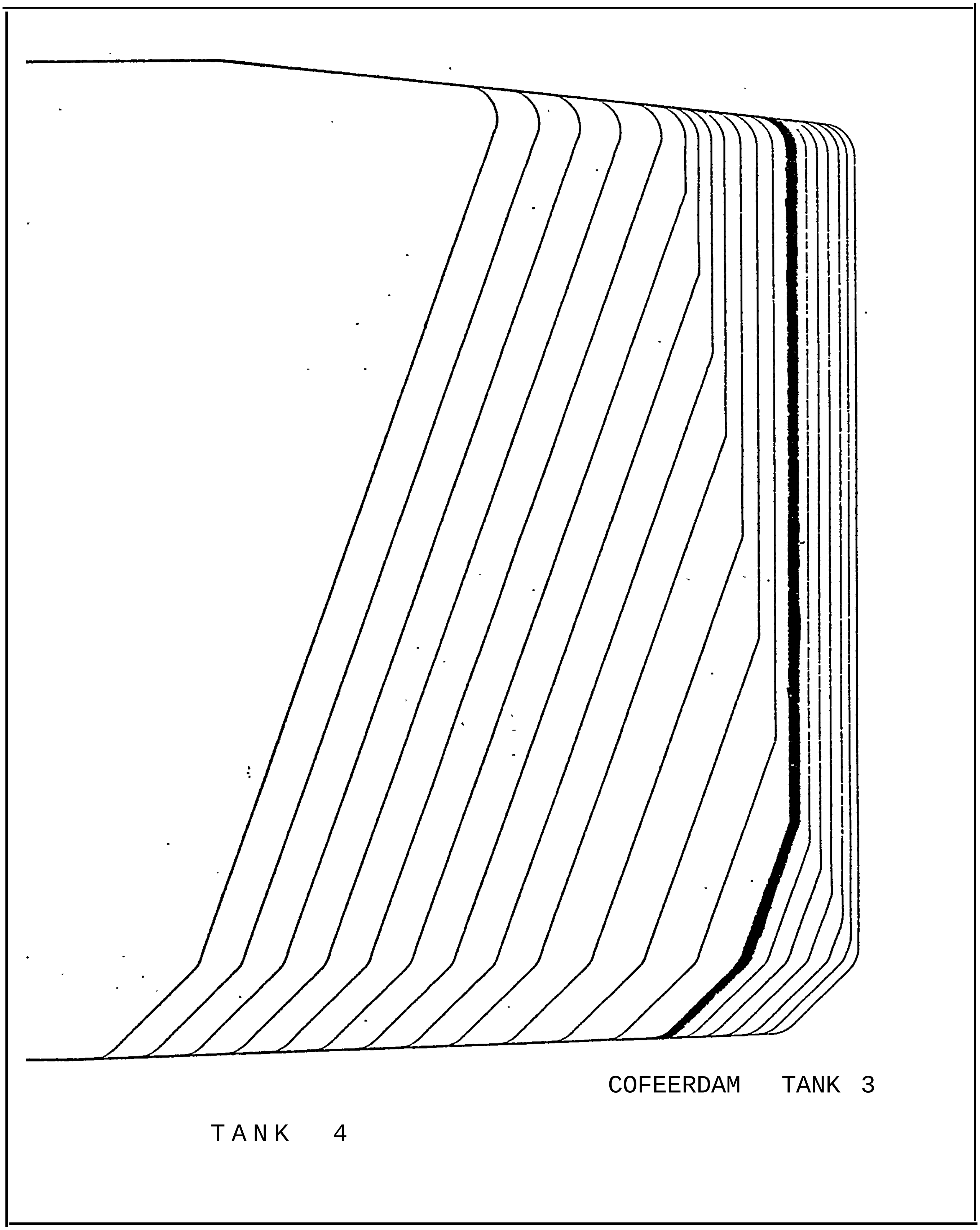


FIGURE No 12
Forward tank geometry - LPGcarrier

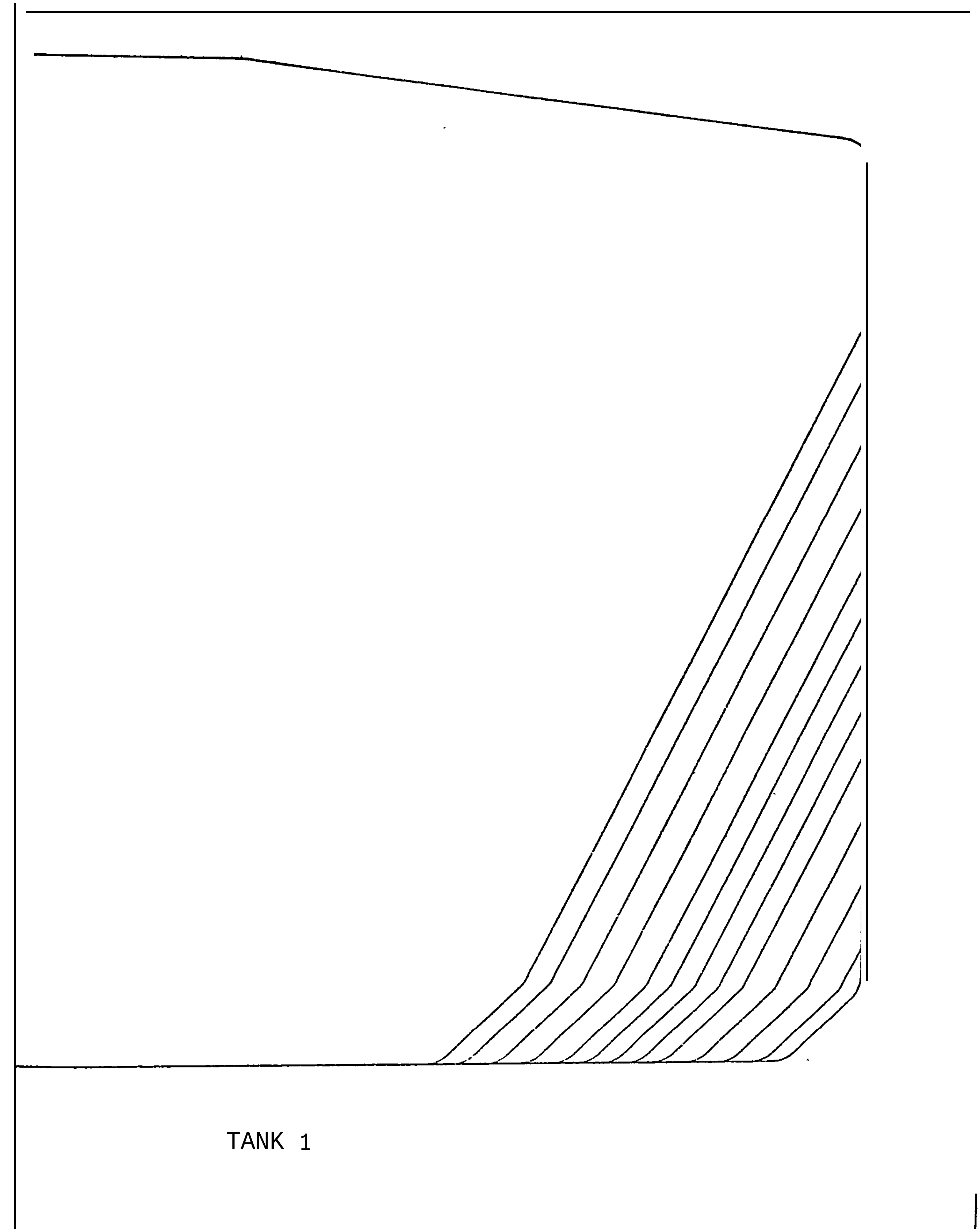


FIGURE No 13

Aft tank geometry - LPG carrier

when using LANSKI for the longitudinal curve calculation (see chapter 3.3.1) . After the modification of LANSKI, this constraint has been removed.
For internal contour, however, one LANSKI run covers the whole ship (no separate aft or fore body) .

A problem connected to the Part Coding is what to call 2 GENACONS within the same part description once the table of longitudinal elements is fixed. To solve that, we were forced to create a new GENACON (= GENACON l00) by aid of the AUTOKONJ language.
This GENACON was called only when the description needed a contcur generation. An example is given in the following.

E x a m p l e

Without GENACON 100	With GENACON 100
YN - , IDN -	Y N y - , I D N -
Generation of ACON	Part Coding
	Generation of 1st ACON
Part Coding with call of ACON	Part Coding
	Generation of 2nd ACON
ESSI	ESSI
FIN	FIN

The result of an example is shown on the figures 14 and 15.

e) TEMPLATE :

The main purpose of such a program at C.N.C. is :

- to calculate in the developed region the plane templates for every 3rd frame and if possible to choose among C.N.C. standard templates.
- to determine in the non-developed region the three dimensional templates.

Presently the C.N.C. version of' TEMPLATE treats only plane.templates for the plates situated in the devaloped regions.

The computed method starts with a determination of a reference plane. For each frame, where it is desired to have a flat template, the program computes :

- all intersection points IT (see figure NO 16) between reference plane and the frame contour.

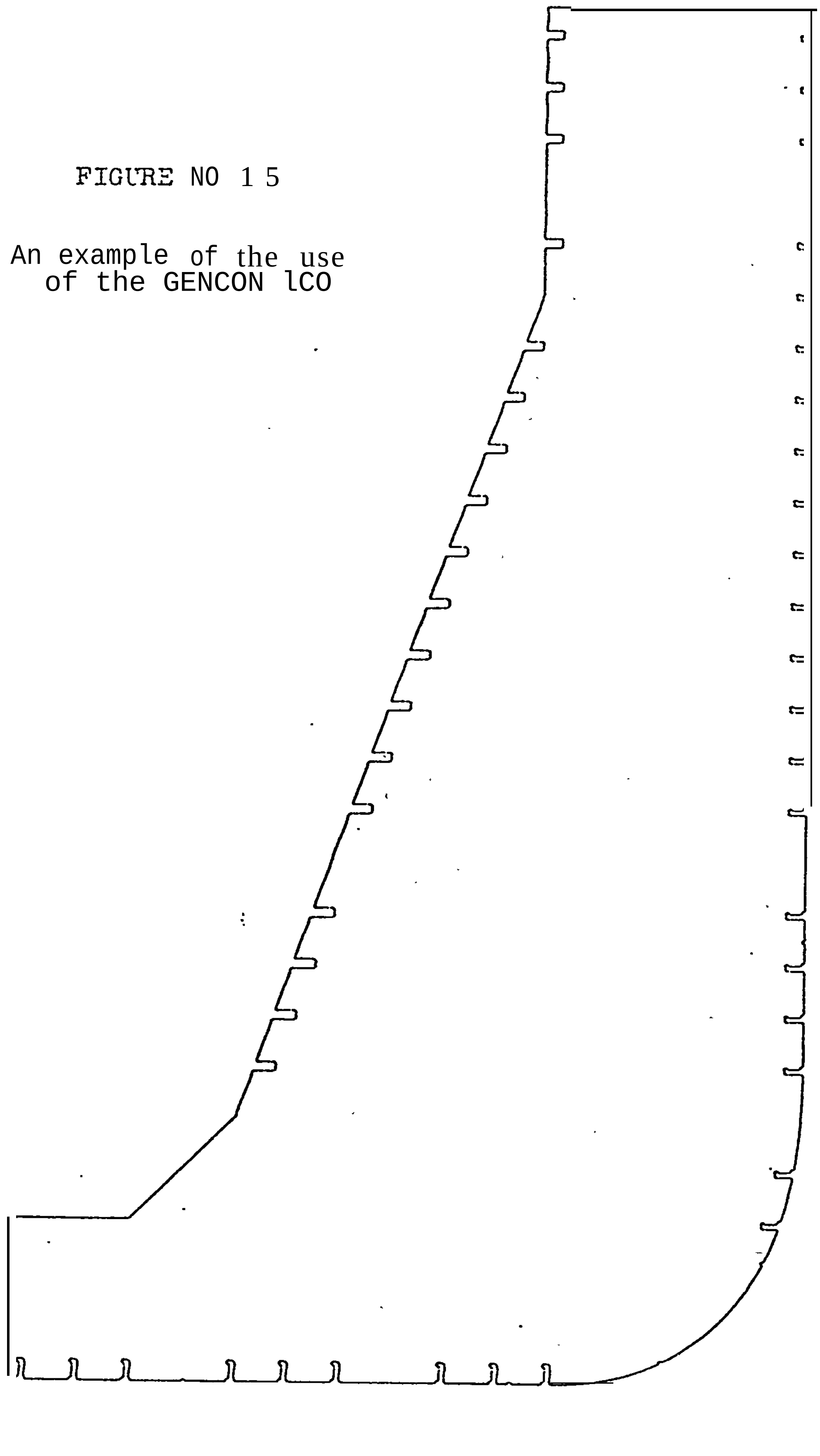
FIGURE No 14

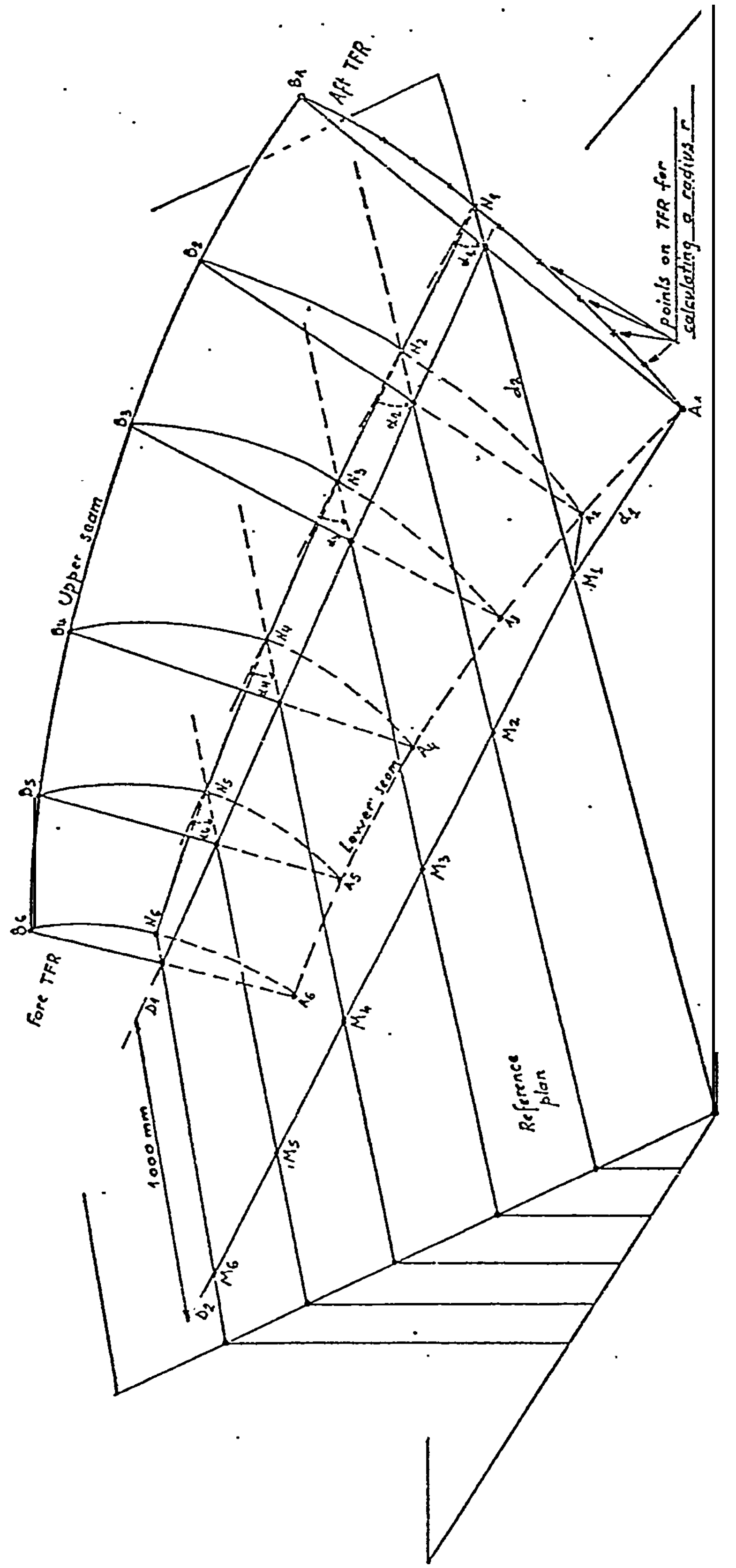
```
NAVIRE   312   PIECE TRAITEE LE 27- 2-76
*****************************************

COMM ( EXCMPLE O UTILISATICN
       DU GEN ACoN 100 )
SPT( +16000+22000)
SL:DIR( +0)IIJT(+100+0)
GEN ACON 100(-fl10+l+41)
INT(+Io()+0)
SL:DIR(+90)  PT(+5000+O)  INT(+IOO*O)
GEN ACON 100{+1212+22+1)
INT(+1OO+O)
SL:DIR(+O) EPT(+16000+2'2000)
ESSI(PRESENTATION FORINT- GEN ACON 100)
FIN
&
```

FIGURE NO 1 5

An example of the use of the GENCON lCO





Aft TFR
Fore TFR
Upper seam
Lower seam
Reference plan
1000 mm
points on TFR for calculating a radius r

Fig. 16

all points M situated in the reference plane on the line D_2 and having all a given distance (1000 mm at C.N.C) from D_1.

- the distances d_1 and d_2. $d_1 = AM$ $d_2 = MN$

10 points on the contour, if the frame does not have any double curvatures in the region concerned . Using these 10 points in a least square method, thc program approximates the contour by a circle segment (see figure No 17). The found radius r may give us an indication for the choice cf a standard template.

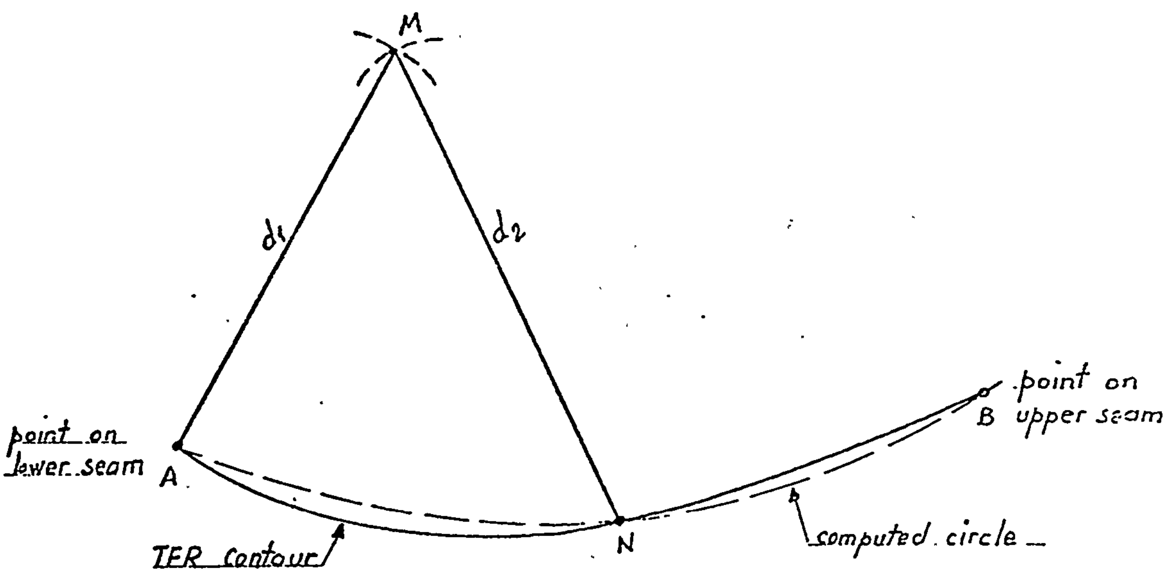


FIGURE NO 17

- finally-the bevel angles in the reference plane are calculated.

The program uses exactly the same input data as SHELL 2.

The results are presented on 2 forms .....

on line printer : The listing consists of necessary identification plus the values of d_1, d_2, r and α for each plate and each template.

as drawings : in scale 1 : 1, which together with the line printer output permit the template construction (as shown in figure No 16).

f) LISSE : calculates for the longitudinal stiffeners with few input data, the width along the frames and some other drawing information. See figure NO 18.

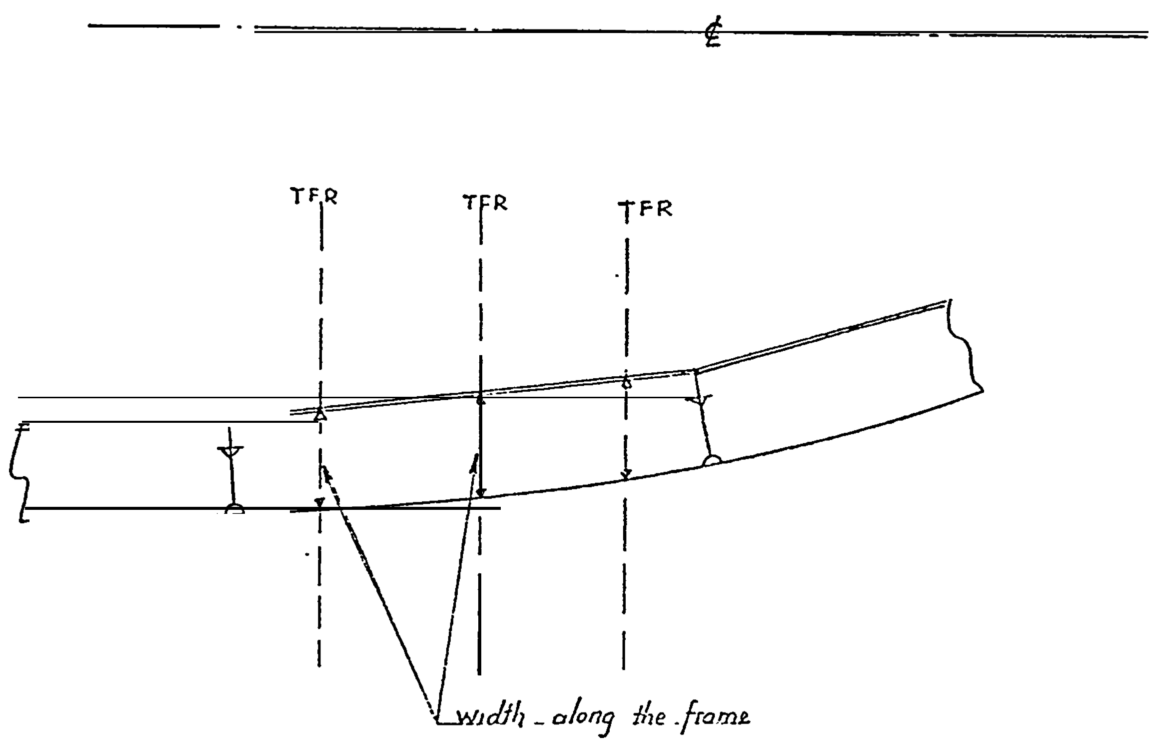


FIGURE No 18

4. RESULTS OF THE USE Of AUTOKON

The results of the AUOTOKON system may be defined in many ways . In this chapter we will concentrate on 2 predominant results, namely the number of employee's after the imp lement at ion of AUTOKON and the recent performance of AUTOKON at C.N.C . illustrated by means of an example .

4.1 Present number of emnloyees *

This number is related to the 2 main C .N. C. departments :

Production department : When AUTOKON took off in 1970, the working group consisted of 7 persons; this number has gradually' been increased as a function of the amount of work undertaken by AUTOKON and has reached the actual number of 32. This group is able to handle simultaneously 3 different types" of ships .

In addition to these persons, the mould left activities necessitate 35 loftsmen; therefore, the actual total number of persons is about 67.

In the days before AUTOKON, the same jobs kept about 80 people occupied for an equal work load.

As a result of AUTOKON, We may say that 13 men have been transferred to other jobs in the production department .

Design Department : As mentioned in Chapter 2.2 the staff trained for AUTOKON tasks includes. :

- 2 draftmen for the body plan fairing (FAIR2).
- 2 draftmen to complete the body plan (LANSKI)
- 1 draftman available for norm writing if it is stillnecessary
- 5 progranurmrs able to ensure the maintenance and the technical assistance.

3 Of these persons can be considered as a supplementary staff. This is mainly due to a job transfer .

4.2 Recent perfornance of AUTOKON

We prefer to present the performance of AUTOKON in a simple way as manhour and CPU time (IBM 370\l35). A 360,000 tdw tanker is chosen as an example because it permit:; discussions during this meeting as it is a type well known by almost all the shipyards present.

* The information given above concerns mainly employees directly concerned by the AUTOKON activities.

- Date of treatment : August 1974
- Ship sections treated by AUTOKON : the whole silip except the superstructure, seatings, some plane panels
- Total number of AUTOKON parts : 11309

  Number of different parts treated by AUTOKON : 6628 *

  Number of nested plates : 1293
- Number of developed plates,

  with SHELL 2 : 474

  manually : 103.(forward and aft endings and wrongly developed plates)
- The number of manhours and CPU time is stated in Table 1 for each AUTOKON module.

* This means that more than half of the parts have been handled twofold by AUTOKON.

TABLE 1

AUTOKON performance for a

360 000 tdw tanker

AUTOKON programs	Manhours	IBM 370\135 CPU hews
F A I R 2	500	40
LANSKI (LNGIN (YAPIN	30 106	6
SHELL 2	90 1012 (control)	7
TEMPLATE (C.N.C. version)	10	1
PART CODING	6630	70
NESTING	1500 **	8

*- This figure concerns the coding of the parts and the COntrol of computed dimensions

The cipher corresponds to :

manual nesting of parts
- definition of input data for NEST 2
control of computer results.

5. FINAL REMARKS

After having solved some difficulties concerning the AUTOKON programs and their implementation, it might be stated generally that AUTOKON satisfies the C.N,C. demands, although some problems still remain, such as :

- speeding up the fairing of the body plan
- shell development

The success of the system is basecl on an easy adaption of the : involved persons to the system and its language . The *figures* given in Table 1 show, in our opinion, reasonable expenses in manhour and computer time.

On the other hand, it is believable that the present AUTOKON level at C.N.C. may not be expanded towards a more complex system without postponing the system conception.

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